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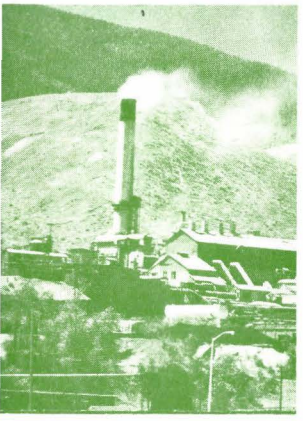

FOREST INSECT & DISEASE MANAGEMENT

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State & Private Forestry · Missoula, MT 59801

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REMEASUREMENT OF WESTERN SPRUCE BUDWORM DAMAGE AREAS ON THE CLEARWATER NATIONAL FOREST IDAHO 1978

By

Wayne E. Bousfield and G. C. Franc 1/

INTRODUCTION

Beginning in 1966 an outbreak of western spruce budworm 2/ was observed on the Clearwater National Forest in Idaho. In 1972, four areas were selected for monitoring the infestation and periodically measuring damage to the stands within these areas throughout the life of the infestation (Franc et al. 1973) (figure 1).

Defoliation intensity has fluctuated in these areas since then, but it was not until 1977 that a marked decline was observed. In 1978 very little defoliation was evident during aerial surveys.

METHODS

In 1972, survey areas were delineated on aerial photographs, and the stands were sampled. Forty basal area factor (BAF) plots were placed on a systematic 5- by 10-chain grid throughout the areas. All trees within the plot, greater than 5" diameter breast height (d.b.h.) were marked and a cedar stake placed at plot centers for future remeasurement purposes. Paint lines referenced the path between plots.

1/ Entomologist, Division State and Private Forestry, Missoula and Forester, Clearwater NF, Orofino, Idaho, respectively.

2/ *Choristoneura occidentalis* (Freeman)

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ROCKY MOUNTAIN STAT

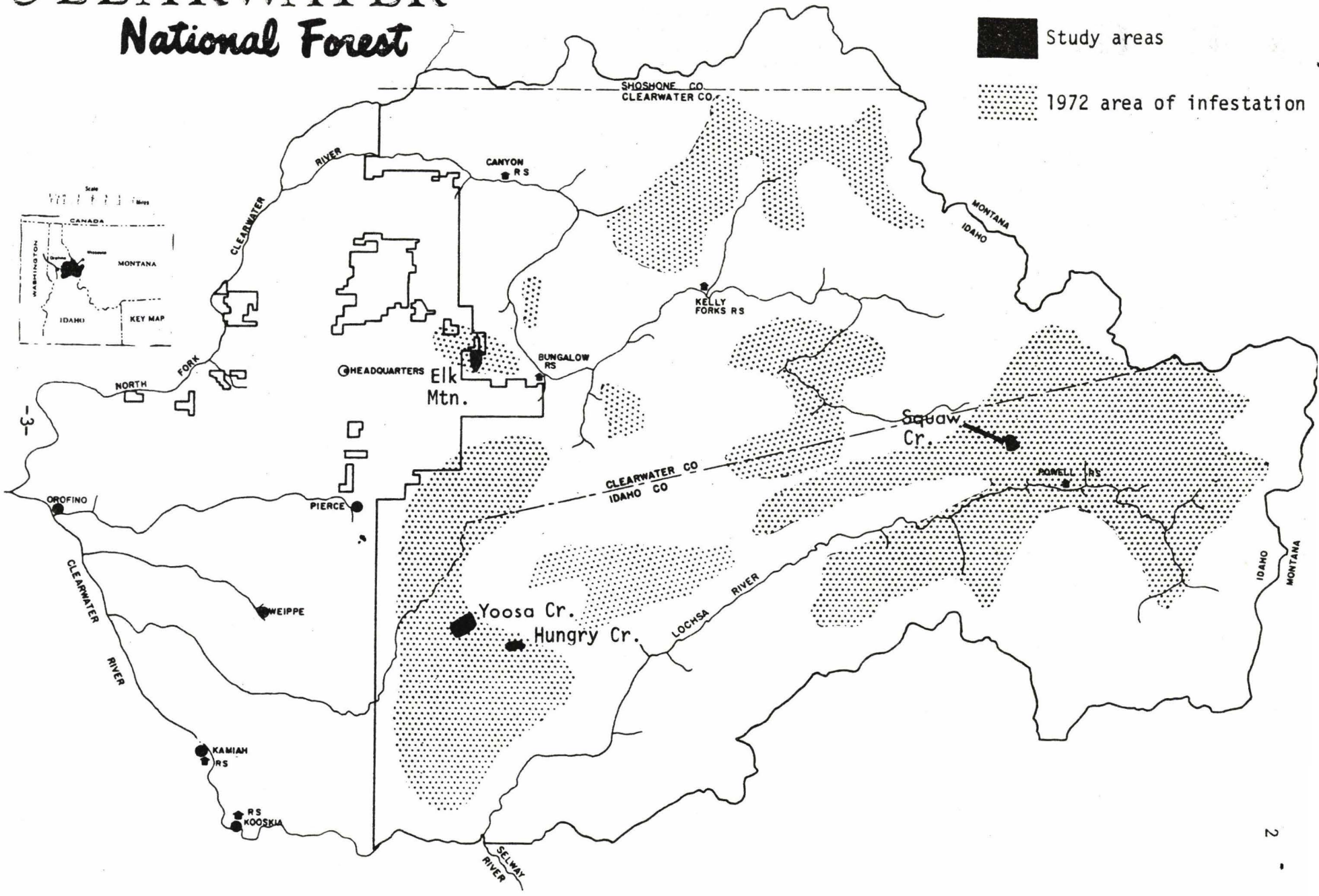

Figure 1.--Evaluation areas for western spruce budworm damage survey on Clearwater National Forest

In October 1978 sample trees were reexamined and basic mensurational measurements of species, diameters, heights, 10-year radial growth, and radial growth prior to the infestation were obtained. Also, detailed information on the amount of defoliation, top kill, or mortality was recorded. The data were analyzed by the computer program "INDIDS" (Bousfield 1979) which computes stand statistics displaying amount of defoliation, top kill, and mortality by various size classes and species.

To obtain Periodic Annual Increment (PAI), sample tree diameters and heights for next year must be calculated. These calculations are made by INDIDS which utilizes existing growth models developed for timber management. The following variables are necessary to drive the model: (1) tree species, (2) diameter, (3) height, (4) habitat type, and (5) 10-year past radial growth.

If top kill codes are present the current tree height is used for actual PAI calculations, but the program utilizes next year's tree heights for estimated PAI calculations. The difference between the two estimates is PAI reduction when converted to volume per acre. Radial growth is measured for both host and nonhost trees and if covariance tests of radial growth measurements between host and nonhost are significant, then the percent difference is used to adjust for diameter growth reduction attributed to defoliation.

RESULTS

Damage symptoms in the four areas were not uniform. In all but one area (Elk Mountain) there was a progression in the amount of visible top kill from 1972 through 1978 (table 1).

Table 1.--Percent of stand volume with visible top kill

Area	Examination period		
	1972	1975	1978
Yoosa Creek	1.2%	7.9%	11.1%
Hungry Creek	5.1%	1/	9.1%
Squaw Creek	7.8%	1/	30.1%
Elk Mountain	2.0%	1/	2.3%

1/ Not examined in 1975.

Periodic Annual Increment reduction ranged from 1.7 to 10.5 percent below the expected PAI as calculated by INDIDS, table 2. This reflects all species in the stand including nonhosts.

Table 2.--Percent PAI reduction by stand

Area	PAI 1/
Yoosa Creek	4.41%
Hungry Creek	4.13%
Squaw Creek	10.47%
Elk Mountain	1.71%

1/ Periodic Annual Increment expressed as annual growth in cubic feet per acre.

Tree mortality attributed to spruce budworm was minimal (0-.09%); however, mortality from other causes ranged from 0.20 to 12.55 percent of the trees per acre.

The growing stock and growth loss expressed in board foot volumes per acre is shown by area in table 3.

Volumes ranged from 11,926 to 29,930 board feet per acre. Greatest board foot growth loss occurred in Yoosa Creek which also had the largest volumes, and the least loss in Hungry Creek with the lowest volumes.

Table 3.--Board foot volumes by species and area

	Board foot volume per acre				
	Growing stock			6-year mortality	
				Spruce budworm caused	Other causes
	1972 1/	1978 2/	1978 3/		
	YOOSA CREEK				
Grand fir	16,366.6	18,833.0	18,994.2	0	852.3
Subalpine fir	1,519.4	1,168.1	1,286.0	100	404.3
Spruce	3,649.5	4,257.7	4,257.7	0	0
White pine	320.0	344.2	344.2	0	0
Douglas-fir	3,626.3	3,950.4	3,957.9	0	277.9
Cedar	1,246.5	1,376.9	1,376.9	0	0
Total	26,728.3	29,930.3	30,216.9	100	1,534.5

Growth loss per acre per year

$$\frac{30,210.9 - 29,930.2}{6 \text{ years}} = 46.7$$

	ELK MOUNTAIN				
Grand fir	3,211.7	3,406.1	3,659.8	0	221.7
Larch	480.8	581.9	581.9	0	0
Spruce	334.6	413.2	413.1	0	0
Lodgepole pine	1,775.6	2,095.7	2,095.7	0	0
White pine	1,137.3	1,087.1	1,087.1	0	256.7
Douglas-fir	4,185.7	4,861.3	4,871.2	0	218.0
Mountain hemlock	355.8	472.9	472.9	0	0
Total	11,481.5	12,918.2	13,181.7	0	696.4

Growth loss per acre per year

$$\frac{13,181.7 - 12,918.2}{6 \text{ years}} = 43.92$$

1/ Board foot volume/acre in 1972
2/ Actual board foot volume/acre in 1978
3/ Expected board foot volume/acre in 1978 if budworm was absent from 1972 - 1978

Table 3.--Board foot volumes by species and area, con.

	Board foot volume per acre				
	Growing tock			6-year mortality	
				Spruce budworm caused	Other causes
	1972 1/	1978 2/	1978 3/		
	HUNGRY CREEK				
Grand fir	1,337.0	1,649.8	1,662.7	0	0
Subalpine fir	3,617.2	4,000.0	4,045.2	0	433.0
Larch	1,182.4	1,300.8	1,300.8	0	0
Spruce	2,371.5	2,903.2	2,903.2	0	0
Lodgepole	487.2	541.8	541.8	0	0
Douglas-fir	1,262.2	1,530.3	1,536.9	0	0
Total	10,257.5	11,925.9	11,990.6	0	433.0

Growth loss per acre per year

$$\frac{11,990.6 - 11,925.9}{6 \text{ years}} = 10.8$$

	SQUAW CREEK				
Grand fir	3,306.9	3,887.8	3,965.2	0	0
Subalpine fir	1,341.2	1,475.9	1,529.5	0	0
Spruce	5,403.0	4,660.1	4,734.2	0	1,247.1
Douglas-fir	999.5	1,186.6	1,186.6	0	0
Cedar	1,671.5	1,994.6	1,994.6	0	0
Total	12,722.1	13,205.0	13,410.1	0	1,247.1

Growth loss per acre per year

$$\frac{13,410.1 - 13,205}{6 \text{ years}} = 34.18$$

CONCLUSIONS

The greatest impact caused by western spruce budworm defoliation in the areas examined is growth loss. PAI reduction of 1.71 to 10.47 percent per acre has occurred annually since 1972. Growth loss ranged from 10.8 to 46.7 board feet per acre per year for the last 6 years and will continue until the damaged tree crowns recover and normal height and diameter growth rates resume.

Top kill ranged from 2.3 percent to 30.1 percent with the amount of top kill increasing as the duration of the infestation increased. Top kill was most severe in grand and subalpine fir.

Budworm-caused mortality is difficult to assess; however, no appreciable amount was observed. Future evaluation on the recovery of these areas is planned. More information on top regrowth and normal diameter growth is needed to fully assess the impact of spruce budworm outbreaks.

LITERATURE CITED

Bousfield, Wayne E. 1979. Region 1 forest insect and disease damage survey system. USDA, Forest Service, Forest Insect and Disease Management, Missoula, Mont. Report 79-2.

Franc, G. C., P. W. Underwood, and J. E. Dewey. 1973. Some observations on the impact of western spruce budworm on the Clearwater National Forest, Idaho. USDA, Forest Service, Div. of State and Priv. Forestry, Missoula, Mont. Report 73-21.